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ABSTRACT

A discussion of PERT is presented. PERT is an acronym for Project Evaluation and Review Technique. The first step in a PERT analysis is to list every activity required to accomplish the project. This is accomplished in three stages: (1) listing of major tasks, (2) assigning dates to each of these tasks, and (3) listing activities which must be performed to accomplish each task. Once a project begins, the manager should hold regular meetings with the task leaders to reanalyze the schedule. The implications of any variances can be discussed in conjunction with supplementary PERT analyses. PERT is recommended for good project results. (CK)

Expanding Evaluation Concepts:
Applications and Reflections

What You Always Felt You Should Know About PERT, But Were Afraid to Find Out

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What You Always Felt You Should Know About PERT, But Were Afraid to Find Out

What is PERT?

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What is PERT?

PERT was developed in 1958 by the Special Projects Office of the Navy Department to coordinate all activities involved in developing the Polaris submarine. It has subsequently been used in virtually every industry and profession, including the educational field.

PERT is an acronym for Project Evaluation and Review Technique. The evaluation phase usually occurs during the writing of a proposal as the time schedule is being developed. It has tremendous value at this stage by requiring a clear definition of each and every activity, in order to simulate the performance of the complete project. The review phase involves the monitoring of the project once it has begun.

How is a PERT analysis developed?

The first step in a PERT analysis is to list every activity required to accomplish the project. This will be done in stages. First, list the major tasks--develop the instrumentation, contact participants, administer the test, prepare reports, etc. Next, assign approximate dates to each of these tasks to get a general idea of the overall time frame. Then, in conjunction with the individuals involved, list the activities which must be performed to accomplish each task. For example, test administration would also involve such diverse activities as: hiring and training test administrators, arranging for and preparing testing sites, and shipping the materials before and after the administration. Each of these might easily be divided into several additional parts, and so, the list of activities becomes more and more detailed.

As this list is being developed, it is necessary to indicate the relationships between the activities. Which ones have to proceed sequentially? Which ones can proceed in parallel? Are there several strings of activities with common beginnings and ends? Sometimes there are activities which can be done either sequentially or in parallel. Two similar jobs can be done at the same time by two different people, or one person can work on one job until finished and then start the second job.

Another input to the PERT analysis that should be indicated as the list of activities is being developed is the time duration of each step. How long will this activity last? All of the projects I have been involved in have used a working day as the unit of time. It is by no means the only base, but surely a most convenient one for educational studies.

Is there any convenient way to represent this visually?

Yes, a flowchart is quite handy for this, and I recommend that at least a rough one be drawn as the activities are being listed, related and timed. A handy way of doing this is to list the activities separately on 3 x 5 index cards. These can be spread-out (across the floor if need be) in the order in which the activities will occur. Parallel processing

of course involves parallel strings of cards. The cards are easily shifted to accommodate alterations in the processing.

If the cards are numbered, it is a simple matter to note on each card the number of the preceding card or cards. In this way not only is the network of cards easily reproducible, but this notation fully describes the relationships.

Shouldn't the time duration be noted on each card?

Yes, these estimates should be included in order to develop the detailed project timing. I suggest though, that until you have had experience with PERT, that single time estimates be made for each activity. This is in contrast to the three estimates--pessimistic, optimistic and most likely--required for a probabilistic PERT analysis.

The inclusion of the human and physical resources on each card allows one to spot conflicting demands. The sooner these are discovered the more easily alternatives can be arranged. The listing of resources also provides a simple means of costing the project.

Do people really fiddle with all these index cards?

Definitely. This procedure is used quite often at ETS to develop the input data for our computerized PERT system. It has even been used in the past to monitor the progress of several projects. However, the use of index cards can become quite cumbersome, and their usefulness as a monitoring device is limited to small projects.

As a tool for the neophyte, I think index cards are a great asset. Each major task is developed separately by this process and transferred to paper as a flowchart. After all the tasks are developed and flowcharted, the separate flowcharts are combined to determine the overall interrelationships and resolve conflicts. The index cards are then modified as necessary, and used as source documents for keypunching computer input.

What if a computer is not available?

If you don't have a computer, index cards are probably the next best thing. However, recognize their limitations and keep things simple.

If you do have access to a computer, it is almost certain that there is a PERT system available for it. Find a computer oriented person who either knows the PERT system or is willing and able to take the time to learn it, and it does take time.

At ETS we utilize IBM's Project Management System IV (PMS) on our IBM system 360/65 computer. This is a large PERT package involving three separate processors--Network, Cost and Resource Allocation. After more than a year, I'm still discovering things in the Network processor which I use frequently. I have yet to find time to learn to use the other two processors.

Why is a computer needed after all this work has been done with index cards?

True, a tremendous amount of work is required to get to this point and great insight into the workings of the project has been gained. However, the detailed list of activities, and the flowchart showing their relationships and durations have not answered the basic question--Can the project be completed on time? You would be surprised how seldom the answer to this question is yes. It is here that a computerized system is most advantageous. Within seconds the computer analyzes the complete network (without missing a single relationship) and not only tells how far off you are, but also indicates exactly where time must be made up, and how much is required to complete the project on schedule.

How is all this accomplished?

To begin the process, the index card data is converted to a computer readable form, and stored in the computer one record per activity. By adding to this the project start and end dates, and possibly some intermediate milestone dates, the PERT analysis is ready to begin.

First, the early start and early end dates are determined for each activity. The early start date is the earliest date at which the activity can begin, assuming that all preceding activities finish as soon as possible. The early end date is simply the early start date plus the duration. This process is known as the foreward calculation and is performed on each activity working forward sequentially from the project start date.

Next, the late start and late end dates are calculated for each activity utilizing a backward calculation. This process is performed on each activity working backward sequentially from the project end date. The late end date is the latest date at which the activity can finish assuming that all succeeding activities begin as late as possible. The late start date is the late end date minus the duration.

Why are these four dates needed?

They indicate how early in the schedule each activity can be performed, and also the time period by which it must be accomplished. The difference between these two sets of dates is called the slack or float. This indicates how much leeway is available after an activity can begin before it must begin.

One standard output from any PERT processor should provide a listing of all activities, with their time durations, and an indication of their relationships. It should also include these four dates, the early and late, start and end dates, and the slack.

How is the PERT output used?

Let me illustrate the use of PERT by discussing the first project I was involved in, in which we used PMS. This project, the National Longitudinal Study of the High School Class of 1972 (NLS) was sponsored by the United States Department of Health, Education and Welfare, Office of Education (OE). The request for proposal (RFP) arrived at ETS in late November, 1971 with a return date one month later and a notification of contract to be given by February, 1972.

The RFP suggested a mid-March 1972 testing date and gave the following breakdown of major tasks to be accomplished in that first month-and-a-half.

Obtain endorsement of all 50 Chief State School Officers.

Develop and implement a school sampling plan.

Secure school district endorsements and then the cooperation of 1,200 schools.

Develop and implement a student sampling plan.

Modify, print, pretest, remodify, print and distribute a 60 page student questionnaire for 20,000 students.

Develop, print and distribute supplementary materials.

Develop receipts control and follow-up procedures.

It seemed an impossibility to compress all of this into such a short time, and the first PERT analysis confirmed our pessimism. Everywhere we looked, there were negative slacks--activities whose late dates preceded their early dates, which meant they had to start before they could start.

How is negative slack eliminated?

The first PERT analysis indicated that the test booklets could not possibly be ready until August, five months after they were needed for the March testing date. Thus we had five months negative slack in a two month portion of the project. It didn't take long to discover the reason for this anomaly. OE had added their standard proviso (and rightly so) that the Office of Management and Budget (OMB) would review and clear all instrumentation.

However, their time requirement for this was one month for each instrument. By reanalyzing the network with a one week turn-around for clearance, and by shifting the testing date from March to April, we were able to reduce the negative slack to less than two weeks. By judiciously adding resources to critical activities and redefining the relationships between certain others, we were able to eliminate all negative slack in our planned schedule. By the time the contract was signed in late January, OE and OMB had agreed in principle to the need for a one week review period and, in actuality, not one of the seventeen instruments took more than a week for clearance.

How is PERT used to monitor a project?

Once we received the NLS contract, we found that the initial analyses provided a tremendous information base to utilize in the day-to-day management of the project. Updates were made to this data base daily, both for completed activities, and for those which fell behind schedule. A new PERT analysis was run every afternoon to see what effect each day's changes would have on the overall schedule. Three of us scrutinized these daily analyses and potential trouble spots were immediately brought to the attention of the responsible person. Thrice-weekly luncheon meetings were held with the six task leaders to review the overall schedule.

If anyone felt the network needed a major modification, a separate PERT analysis was performed to simulate the effect of the change. This analysis was then discussed at our regular luncheons and provided a defensible basis for implementing the change (or not).

Weekly, a new flowchart was developed from the then most recent PERT analysis. Completed activities were so designated, and any variations from the previous flowchart were indicated and annotated. Copies of the flowchart were distributed to both ETS and OE personnel, thus providing an updated pictorial representation of the project, as a reference point whenever discussions were held.

How does the project manager get everyone to comply with the PERT developed schedule?

How does a manager get people to comply with any schedule? One advantage of a PERT schedule is that the people who develop it are the ones to be bound by it. Each task leader has the responsibility of developing for his section the initial list of activities, including durations and relationships. The only restriction being the overall time frame. If the initial PERT analysis shows that the activities, as listed, do not fit the time frame, the task leader must redesign his section to conform to the overall schedule. This is all done while writing the proposal, so that it is even possible to change the overall schedule if necessary. The final schedule, agreed upon by everyone, should be included as part of the proposal.

Once work begins, the project manager should hold regular meetings with the task leaders to reanalyze the schedule. The implications of any variances can be discussed in conjunction with supplementary PERT analyses. Again, it should be the task leaders who redevelop the schedule. The project manager's main function becomes one of noting the completion of all activities, bringing to the task leaders' attention those off-schedule activities which have major implications for the overall schedule.

Since the title of this paper and its style are such obvious take-offs on a very popular book by Dr. Reubens, I feel I must end the paper with the equally popular and appropriate expression taken from an Alka-Seltzer commercial--"Try it, you'll like it".